DETERMINATION OF WATER QUALITY STATUS AND HEAVY METALS FOR SELECTED RIVER AT TASIK CHINI DUE TO LAND USE ACTIVITIES

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Tujuan kajian ini dijalankan adalah untuk mengkaji tahap kualiti air pada masa sekarang di sungai sekitar Tasik Chini iaitu Sungai Jemberau dan Sungai Chini pada musim kemarau tahun 2018 dan musim hujan tahun 2019. Terdapat tiga belas jenis parameter kualiti air dan tujuh jenis logam berat yang telah dibuat ujikaji dan dikelaskan berdasarkan Indeks Kualiti Air iaitu daripada Jabatan Alam Sekitar (DOE-WQI) dan Piawai Interim Kualiti Air Kebangsaan, Malaysia (INWQS). Antara parameter kimia dan fizikal yang telah dianalisis ialah pH, suhu, kekeruhan, Kekonduksian Elektrik (EC), Pepejal Terampai (SS), Jumlah Pepejal Terampai (TSS), Oksigen Terlarut (DO), Permintaan Oksigen Biokimia (BOD), Permintaan Oksigen Kimia (COD), Nitrogen Ammonia (NH3-N), Kalium (K), Nitrat (N) dan Fosforus (P) yang telah dianalisis di lokasi sampel diambil dan ujikaji di makmal juga dilakukan. Selain daripada itu, terdapat tujuh jenis logam berat yang telah diujikaji di makmal untuk mengenalpsti kepekatan logam berat yang terdapat di dalam sampel air daripada Sungai Chini dan Sungai Jemberau. Kuprum (Cu), Kromium (Cr) Kadmium (Cd), Ferrum (Fe), Zink (Zn), Mangan (Mn) dan Plumbum (Pb) telah diuji menggunakan alat yang terdapat di makmal iaitu Atomic Absorption Spectroscopy (AAS). Di samping itu, kepekatan logam berat untuk sampel tanah semasa musim hujan yang diambil berhampiran Sungai Jemberau telah diuji di Makmal Berpusat Universiti Malaysia Pahang dengan menggunakan alat Inductively Coupled Plasma Mass Spectrometry (ICP-MS), manakala sampel air dari Sungai Jemberau dan Sungai Chini semasa musim kering telah diuji dengan menggunakan kepekatan logam berat untuk sampel tanah yang diambil berhampiran Sungai Jemberau telah dibuat ujikaji di Makmal Berpusat Universiti Malaysia Pahang dengan menggunakan alat Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Menurut hasil kajian yang telah dibuat mengikut Indeks Kualiti Air (WQI), kualiti air di lokasi terpilih iaitu Sungai Jemberau dan Sungai Chini yang terletak berhampiran Tasik Chini telah dikelaskan sebagai Kelas III yang bermaksud air di sungai tersebut memerlukan rawatan secara meluas untuk memastikan kualiti air kembali bersih dan selamat digunakan sebagai air minuman kepada penduduk tempatan di masa hadapan. Menurut hasil kajian yang telah dijalankan, terdapat aktiviti yang dilakukan di sekitar Tasik Chini yang telah menyebabkan berlakunya pencemaran air yang melibatkan pelepasan logam berat. Antara aktiviti yang telah dikenalpasti sebagai penyebab utama pencemaran air di Tasik Chini ialah perlombongan besi, pertanian, pembalakan haram dan pembuangan sisa buangan daripada kawasan penempatan seperti tapak Program Latihan Khidmat Negara (PLKN).

ABSTRACT

The purpose of this study is to investigate the current water quality levels in the rivers around Lake Chini namely Jemberau River and Chini River during the dry season of 2018 and the rainy season of 2019. There are thirteen types of water quality parameters and seven types of heavy metals have been made experimental and classified based on the Water Quality Index which is from the Department of Environment (DOE-WQI) and the National Water Quality Interim Standard, Malaysia (INWQS). There are chemical and physical parameters that have been analyzed such as pH, temperature, turbidity, Electrical Conductivity (EC), Suspended Solids (SS), Total Suspended Solids (TSS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonia Nitrogen (NH3-N), Potassium (K), Nitrate (N) and Phosphorus (P) were analyzed at the sample site and laboratory experiments were also performed. In addition, there are seven types of heavy metals that have been tested in the laboratory to determine the concentration of heavy metals contained in the water samples from the Chini River and the Jemberau River. Copper (Cu), Chromium (Cr) Cadmium (Cd), Iron (Fe), Zinc (Zn), Manganese (Mn) and Lead (Pb) were tested using laboratory tools named as Atomic Absorption Spectroscopy (AAS). In addition, heavy metal concentrations for soil samples during rainy season taken near the Jemberau River were tested at the University Malaysia Pahang Central Laboratory using Inductively Coupled Plasma Mass Spectrometry (ICP-MS), while water sample from Jemberau River and Chini River during dry season were tested by using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Based on the results of the study conducted according to the Water Quality Index (WQI), the water quality at selected locations which are Jemberau River and Chini River located near Lake Chini was classified as Class III which means water in the river requires extensive treatment to ensure water quality return clean and safe to use as drinking water to the locals in the future. According to the results of the study, there are activities conducted around Lake Chini which have caused water pollution which involves the release of heavy metals. Among the activities identified as the main cause of water pollution in Lake Chini are iron mining, agriculture, illegal logging and waste disposal from residential areas such as the National Service Training Program (PLKN).

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LIST OF ABBREVIATIONS

AAS	Atomic Absorption Spectroscopy
AN	Ammoniacal Nitrogen
APHA	American Public Health Association
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
DOE	Department of Environment
EC	Electrical Conductivity
FE	Iron
HACH DR 5000	Spectrophotometer Procedures Manual
H_2SO_4	Sulphuric Acid
K	Potassium
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ICP-OES	Inductively Coupled Plasma-Optical Emission Spectrometry
Mg	Magnesium
Mg/L	Milligram per litre
Na	Sodium
NH3-N	Ammoniacal Nitrogen
NO^{-3}	Nitrate
NTU	Nephelometric Turbidity Units
NWQS	National Water Quality Standard
pH	Potential Hydrogen
$PO^{3}{}_{-4}$	Phosphate
SI	Sub-indices
TSS	Total Suspended Solid
μs/cm	Microsiemens per centimetre
WQI	Water Quality Index

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Water is very important to human daily life. The quality of water that free from heavy metals from rivers, lakes, streams and ocean is very important for human in order to do their daily routine especially for drinking. Lakes are important source of freshwater which account only the very small part of around 0.01 percent of the global amount of water. Lakes are one of major water source in Malaysia as freshwater because they are often fed by rivers, rain and springs. The lake is very sensitive area because of the potential exposure pollutants from many sources. For example, pollution can flow through the water body of the lake by connecting to the river, water from runoff and from the deposition of atmospheric. The limited water movement within the lake affects the level pollution in the lake environment. Moreover, high concentrations pollutants can reduce the biodiversity of the lake ecosystem and change the physical environment around the lake.

In Malaysia, Tasik Chini which is located within the state of Pahang on the east coast of Peninsular Malaysia is the second largest natural lake in Malaysia after Tasik Bera. Surface area of the Tasik Chini covers 12,565 acres and it was surrounded by natural forest and aboriginal settlements. Tasik Chini has a unique shape that consists of 12 small lakes that local people called as “Laut” which is interconnected by natural channels. Tasik Chini has recreational value and ecological importance in terms of its biodiversity as this area richly endowed with biological resources and some 288 species of plants, 21 species of aquatic plants, 92 species of birds, and 144 species of freshwater fish.

1.2 Problem Statement

Tasik Chini is an ecological area which is importance due to large biodiversity and it is also very important for local parties' economy. The mainstay economy is mainly forest-based and agriculture-based activities (Habibah et al., 2013). These activities could be the source for pollution to the lake. There is logging, iron ore mining, rubber plantation, palm oil plantation and residential area. There is presence of heavy metals that come from iron ore mining activities which gives bad effect to water quality of Tasik Chini. Accumulation of metals and organic pollutants in the sediments may have long-term adverse effects on aquatic organisms (Sun et al., 2018).

Heavy metals concentration such as Lead (Pb), Iron (Fe), Manganese (Mn), Cadmium (Cd), Zinc (Zn) and Chromium (Cr) become increasing due mining activities. Heavy metals are a metallic element that has a relatively high density, specific gravity, or atomic weight and has toxic effects (Jamshaid et al., 2018). Meaning that, if there are unwell-operated for mining activity, it will causes increasing of heavy metal concentrations in water body because lake is a stagnant water area surrounding by land which is term water pollution refers to any types of aquatic pollution between two extremes of a highly productive body of water poisoned by toxic chemicals that eliminates living organisms. Water quality is among the most important environmental issues related to sustainable development, especially to ensure national drinking water safety (Gao et al., 2019). So that, it is important to maintain a good quality of water in our life.

1.3 Research Objectives

i. To evaluate the characteristics of each water quality parameters and to analyze the current status of water quality at Jemberau River and Chini River during rainy season in 2018 and dry season in 2019.

ii. To identify current heavy metals level in Jemberau River and Chini River.

1.4 Scope of Study

This research is conducted on October 2018 until February 2019. The location of study area is at Tasik Chini, Pahang. The scope of study in this research is about effect from land use activities to the water quality at Jemberau River and Chini River that are currently facing problem due to mining activity, logging activity and agricultural activity. All of this activity can contribute to the increasing of heavy metal concentration and will give worse effect to the water quality at rivers. The increase in water demands causes more conflict between the human system and the river ecological system (Yan et al., 2018). There are two types of test that were conducted which are in-situ test and laboratory test in order to identify the water quality of selected river near the Tasik Chini. There are 5 in situ tests have been conducted which are temperature, pH, electrical conductivity, dissolved oxygen (DO) and turbidity. For laboratory test, 10 tests are conducted which are Biological Oxygen Demand (BOD_5) test, Chemical Oxygen Demand (COD) test, Total Suspended Solid (TSS) test, Suspended Solid (SS) test, Ammoniacal Nitrogen test, Phosphorus test, Nitrate test, Potassium test, Hardness test and Heavy Metal test.

1.5 Significance of Study

From this study, water quality of selected rivers at Tasik Chini will be determined based on the classification from Interim National Water Quality Standards for Malaysia (NWQS) and Water Quality Index (WQI). The data and result that has been collect and carried out from this research will be useful for water quality record in future studies. This is a good result to safeguard the safety of drinking water in future. Furthermore, by examining the quality of water, it raises awareness among the people surrounding Tasik Chini on the hygiene of their domestic water use. This research will give people surrounding Tasik Chini an understanding on how to protect their daily health and maintain good environment with great ecosystems.

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